that the pelvic girdle in different specimens is not homologous—an assumption which at present seems unjustifiable.

(3) The different variations observed are not discordant with the view that the limb is capable of migrating along the body, on which view it must be supposed that a secondary rostral migration has followed a primary caudal one. Moreover, such a view receives confirmation from the existence of a posterior collector and of a more extensive anterior collector in certain embryonic stages.

"Further Observations on Nova Persei." By Sir Norman Lockyer, K.C.B., F.R.S. Received and Read March 7, 1901.

[Plate 1.]

Since the preliminary note on this star was communicated to the Royal Society on February 28th, observations have been possible on the nights of February 28th, March 1st, 3rd, and 5th, and twenty-four photographs of the spectrum have been taken with the instruments before detailed.

It may be stated generally that the light is slowly waning. On February 28th the star was only slightly brighter than α Persei. On March 1st it was estimated as about equal to α Persei, *i.e.*, about 2·0 magnitude. When it was again visible on the evening of March 3rd, it was distinctly less bright than β Persei, and its magnitude probably near 2·5; on the 5th its estimated magnitude was 2·7.

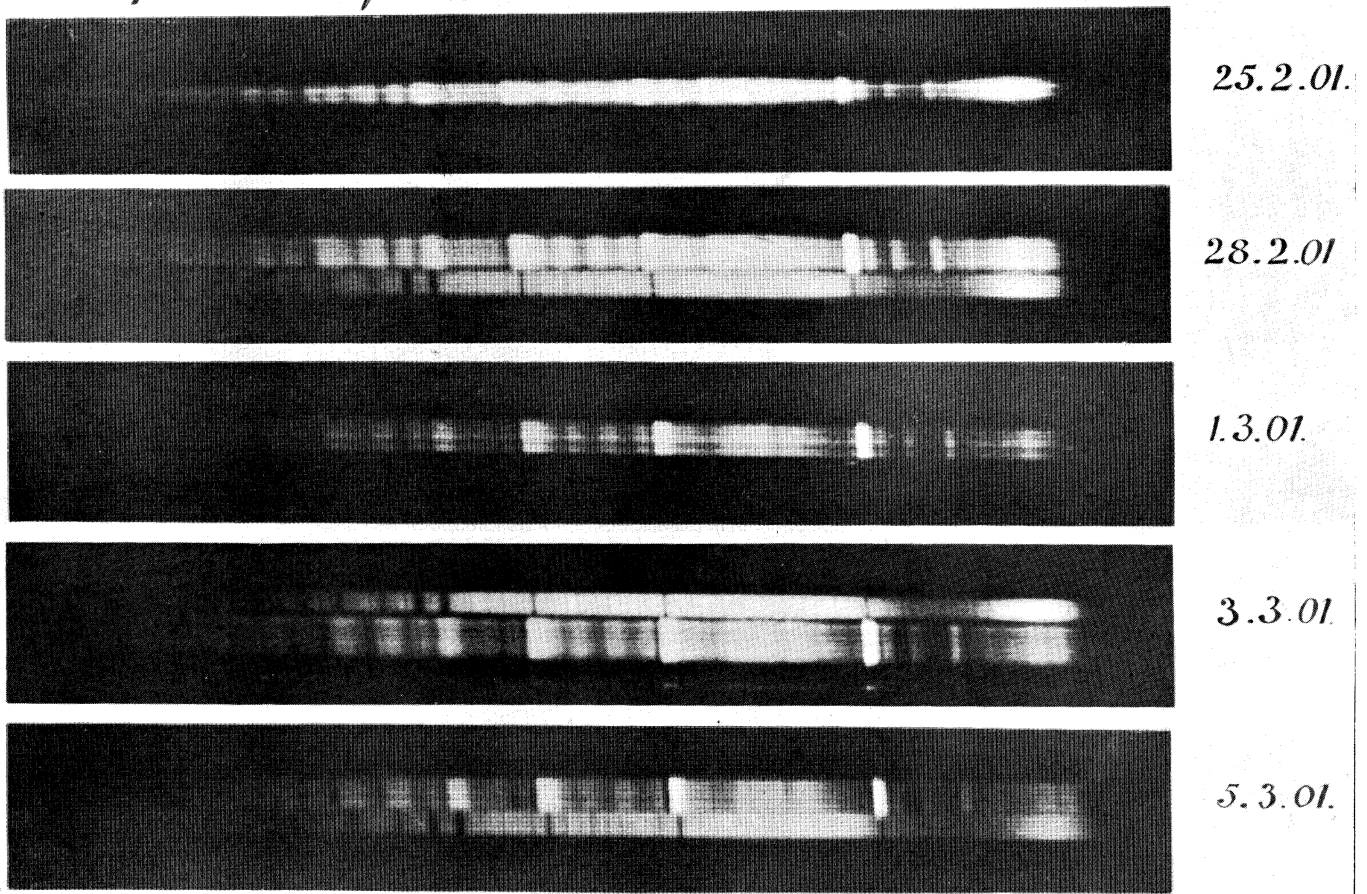
The above refers to the visual brightness. A photograph of the region occupied by the Nova on March 3rd showed it to be photographically brighter than α Persei.

General Description of the Spectrum.

The photographs show that the bright hydrogen lines are successively feebler as the ultra-violet is approached, and the whole of the series of hydrogen lines have during the past week become relatively brighter with respect to the remaining lines and the continuous spectrum. The spectrum extends far into the ultra-violet.

Among the changes which have taken place in the visible part of the spectrum, it may be mentioned that while the lines of hydrogen have become relatively brighter during the past week, the remaining lines, with the possible exception of the prominent one at λ 5169, have become distinctly dimmer. There has also been a diminution of the intensity of the continuous spectrum. The line in the yellow, the identity of which has not yet been definitely determined, has gradually decreased in intensity with the diminution of brightness of the star.

Spectra of Nova Persei, 1901.



SERIES OF PHOTOGRAPHS OF THE SPECTRUM OF NOVA PERSEI.

Taken with 30-inch reflector and with a slit spectroscope of two prisms

(Comparison spectrum in each case is that of α Persei.)

In the visible part of the spectrum the bright green-blue F line of hydrogen has become more conspicuous as the neighbouring green lines have become fainter, and the bright C line is intensely brilliant.

From all these causes, which give us blue light on the one hand and red on the other, the star should present to us the precise quality of red which has been observed.

Colour.

At discovery the star was described as bluish-white. No observations on its variation in hue during its brightening were possible, owing to unfavourable weather conditions. The observations during the period of decline have indicated a change to the present colour of a decided claret red. In comparison with this, it is interesting to note that in the case of the Nova which appeared in 1604, Kepler alludes to purple and red tints assumed by the star.

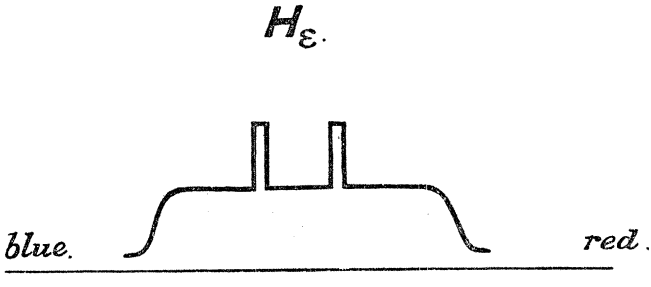
Changes in the Photographic Spectrum.

Between February 25th and March 5th, to take the extreme difference of dates on which photographs were obtained, it has been noted that while some of the dark lines were absent at the later date, either new lines had come in or previously feeble lines had become intensified. There has not yet been time to determine accurately the positions of these lines (see Plate 1).

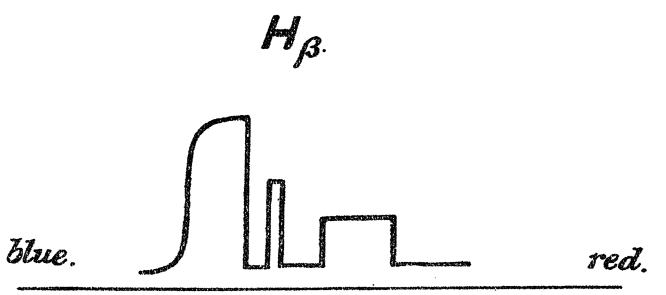
The appearance of the bright lines of hydrogen which I described as being reversed on February 25th, had very materially changed by March 3rd.

In inspecting the dark band representing the bright hydrogen at Hϵ two darker fine lines are seen nearly coincident in position with the edges of Hϵ in the spectrum of α Persei.

To my eye the light curve is as follows:—



The appearance is different in the case of the F line (Hβ), a light curve of which I also give—



No doubt the differences in the appearances are due to the fact that at Hϵ we are dealing with the lines both of hydrogen and calcium.

Rough measurements on the bright line Hβ show that the interval between the centres of the two extreme maxima shown in the light curve corresponds to about 25 tenth-metres. This would give a differential velocity of 960 miles per second between the different sets of hydrogen atoms in the bright-line swarm itself.

It may be then that the appearances described as reversals of the hydrogen lines on February 25th, were but the beginning of the subsequent changes.

The comparisons with stars which have been taken with the slit spectroscope on each evening of observation, indicate that no great change in the velocity of the dark-line component has occurred.

So much, however, cannot be said of the bright lines, in which a change has been observed. In addition to the hydrogen lines the strong lines in the green already ascribed to iron, appear to be double in the photographs most recently obtained.

Comparison with α Cygni.

The view of the apparent similarity between the spectra of Nova Persei and Nova Aurigæ, to which I drew attention in my previous paper, has been strengthened by the comparisons which have since been made.

The bright lines in the spectrum of Nova Persei are so broad, especially in the blue and violet, that accurate determinations of their wave-lengths are difficult to obtain. The lines less refrangible than F, however, besides being more isolated, are narrower than those in the more refrangible part of the spectrum. A direct comparison of these with the lines in the spectrum of a star which is known to contain the enhanced lines of iron, &c., has been considered a better method of arriving at some definite conclusion as to the connection between the Nova lines and the enhanced lines, than that of determining the wave-lengths of the broad lines and comparing the results with the known wave-lengths of the enhanced lines.

The best star for this purpose is α Cygni, but unfortunately no good photograph has been obtained at Kensington of the green portion of the spectrum of that star. The star most nearly approaching α Cygni in relation to enhanced lines is α Canis Majoris, which in the Kensington classification has been placed nearly on a level with the former star, but on the descending side of the temperature curve. In the spectrum of this star the enhanced lines of iron $\lambda\lambda$ 4924·11, 5018·63, $\left\{\begin{matrix}5169{\cdot}07\\5169{\cdot}22\end{matrix}\right.$ and 5316·79 occur as well-marked lines. This spectrum has been directly compared with that of Nova Persei taken with the same instrument, and the fact that all the lines apparently coincide, affords good evidence that the connection is a real one, and that the first four strong Nova lines beyond F on the less refrangible side are the representatives of the enhanced lines of iron. These are the only enhanced lines which occur in that part of the iron spectrum, with the exception of a weak one at λ 5276·17. There is only a trace of this line in the spectra of either the Nova or α Canis Majoris which have been compared. In the spectra of the Nova obtained with lower dispersion, however, a line is distinctly shown in this position, though it is considerably weaker than the four lines previously mentioned.

The absence of the strong lines which are familiar in the arc spectrum, and in the ordinary spark spectrum in this region, is to be ascribed to higher temperature; experiments which are in progress show that under certain conditions, the two lines λ 5018·6 and λ 5169 are by far the strongest lines in the spectrum of iron between λ 500 and D, while that at λ 4924·1 is distinctly stronger than any of the well-known group of four arc lines in which it falls.

The published wave-lengths of the lines of Nova Aurigæ show that the same lines were present in that star. Further investigations of the spectrum of Nova Aurigæ have strengthened the conclusion that most of the lines, after we pass from those of hydrogen, are enhanced lines of a comparatively small number of metals.

When the inquiry is extended into the region more refrangible than Hβ, the evidence in favour of the similarity of the spectra of the two Novæ with that of α Cygni is not so conclusive, because of the greater breadth of the lines (since the spectra have been obtained by the use of prisms) and because of the fact that in this region the enhanced lines of iron frequently occur in groups.

In the region between Hδ and Hγ, however, there is a well marked enhanced line of iron at λ 4233·3 and also two doubles at $\lambda\lambda$ 4173·7, 4179·0, and $\lambda\lambda$ 4296·7, 4303·3, and a comparison of α Cygni with Nova Persei indicates that these fall on broad bright bands of the Nova spectrum.

It is not claimed that all the enhanced lines which appear in the spectrum of α Cygni are represented in that of Nova Aurigæ. There

is, however, a sufficient reason why at a particular stage in the spectrum of such Novæ the enhanced lines of certain substances should predominate. Thus, in γ Cygni, titanium is most strongly represented by enhanced lines; in α Cygni, iron, chromium, and nickel; in β Orionis, silicium and magnesium, and so on. We may thus expect to find the lines of different substances most prominent at different stages in the history of the star.

In the work above referred to I have been assisted as follows:—The new photographs have been taken by Dr. Lockyer and Messrs. Fowler, Baxandall, Shackleton, Butler, Shaw, and Hodgson. The detailed examination of the photographs has been made by Messrs. Fowler and Baxandall. The visual observations have been chiefly made by Messrs. Fowler and Butler. The photographs have been enlarged and the illustrations for this paper prepared by Sapper Wilkie. To all, my best thanks are due.

March 14, 1901.

Sir WILLIAM HUGGINS, K.C.B., D.C.L., President, in the Chair.

A List of the Presents received was laid on the table, and thanks ordered for them.

The following Papers were read:—

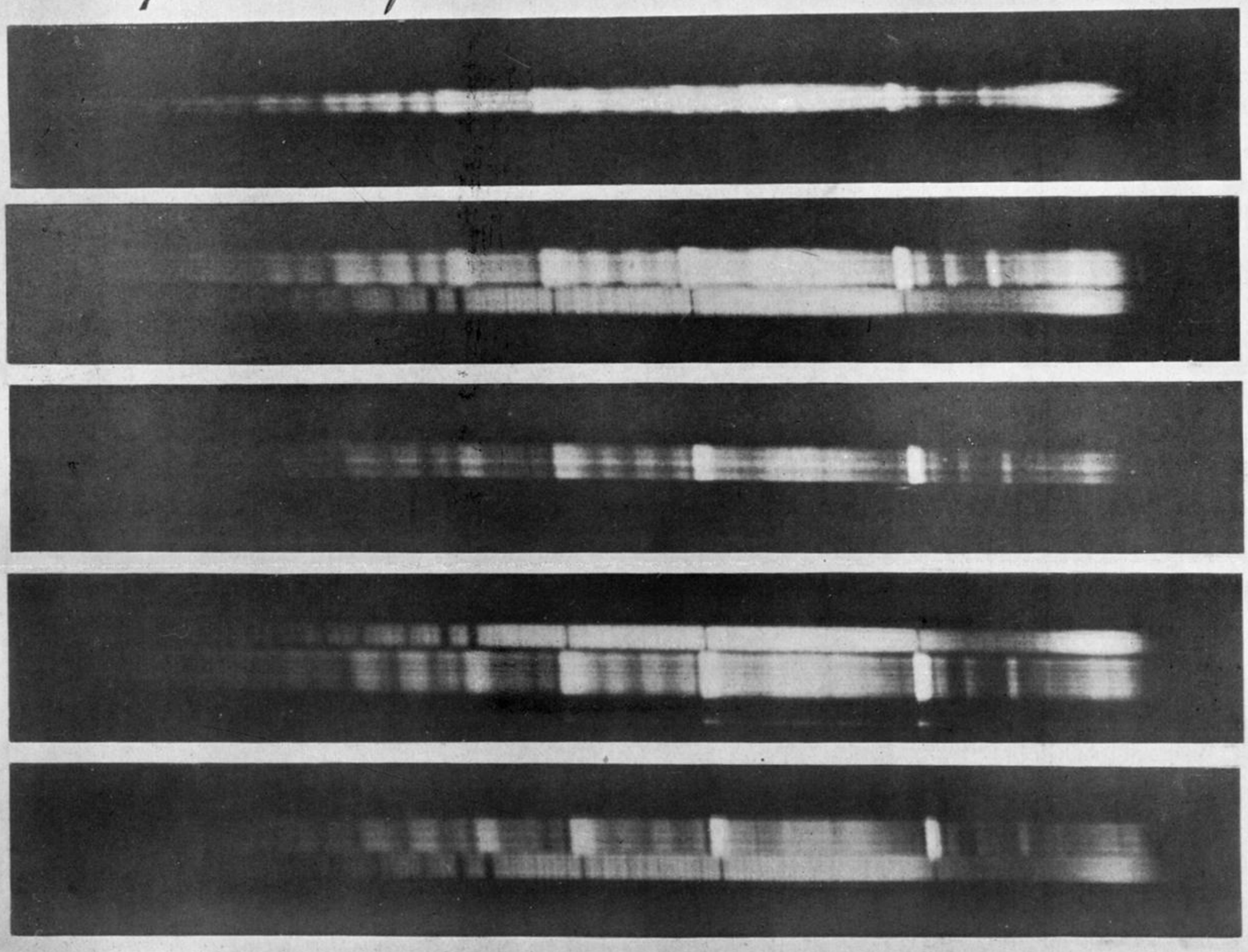
I. "The Action of Magnetised Electrodes upon Electrical Discharge Phenomena in Rarefied Gases." By C. E. S. PHILLIPS. Communicated by Sir W. CROOKES, F.R.S.

II. "The Chemistry of Nerve-degeneration." By Dr. MOTT, F.R.S., and Professor HALLIBURTON, F.R.S.

III. "On the Ionisation of Atmospheric Air." By C. T. R. WILSON, F.R.S.

IV. "On the Preparation of Large Quantities of Tellurium." By E. MATTHEY. Communicated by Sir GEORGE STOKES, Bart., F.R.S.

Spectra of Nova Persei, 1901.



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